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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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34704 7590 04/30/2008 BACHMAN & LAPOINTE, P.C. 900 CHAPEL STREET SUITE 1201 NEW HAVEN, CT 06510			EXAMINER PADGETT, MARIANNE L	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/805,922

Applicant(s)

ULION ET AL.

Examiner

MARIANNE L. PADGETT

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 11 January 2008.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 26-44 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 26-44 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-946)
- 3) ☐ Information Disclosure Statement(s) (PTO/SG/US)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

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1. Applicants' amendment of 1/11/2008 have canceled all previous claims & rewritten the method claims, such that 112, second issues previously set forth in section 6 of the action mailed 10/9/2007, have been removed.

The 102 & 103 rejections with respect to Movchan et al. (EP 1327698 A1) set forth in section 8 of the action mailed 10/9/2007 did not include original dependent claims 12 or 13, which in some fashion have been wholly or partially incorporated in the newly presented claims, along with other limitations, such that this reference, by itself, no longer reads on applicants' claimed invention.

2. Applicant's election without traverse of group I, method claims 1-15 in the reply filed on 1/11/2008 on the first page of their Remarks is acknowledged.

3. Claim 27 is objected to because of the following informalities: in lines 2-3 of claim 27, the limitation "a zirconium based ceramics₂" (emphasis added) is grammatically incorrect, since the article is singular & been known is plural. Appropriate correction is required.

4. Claim 26-34, 41 & 43-44 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

In new claims 26 & 44, applicants' claim depositing an additional thermal barrier coating (TBC) that is substantially free up fugitive material **subsequent** to formation of the porous network, however they have provided no showing of support for this limitation, nor did the examiner find any explicit support for this newly specifically claimed limitation. While original claim 12 was ambiguous or nonspecific as to **when** the additional layer of TBC substantially free up fugitive material was deposited, it does not support specifically claiming subsequent & review of the original specification found no suggestion that this deposition was contemplated to take place after formation of the porous network. Particularly see [0020] in the original specification, which provides the option of depositing "at least one

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layer containing no fugitive from material", however these depositions are all taught to take place before the heat treatment, such that the results after heat treatment is to have at least one layer with the density substantially undiminished by the liberation of fugitive. Paragraph [0023] further discusses options for depositing the ceramic matrix material & the fugitive material, including alternating layers during the evaporation that will be dense & porous after heat treatment, where the alternating option was performed so as "to provide an **initial and final** application of dense (i.e. "substantially pure") 7YSZ..." (emphasis added), hence the context is clearly in the sequence of evaporant depositions that take place before porous network formation, thus cannot provide support for applicants' independent claim 26 (and its dependents) or dependent claim 44 as now written, thus these claims appear to incorporate **New Matter**. Specific claims to depositing a TBC layer free of fugitive material after formation of the porous network cannot be considered to derive adequate support from the nonspecific all-encompassing language of the original dependent claim 12, especially in light of the original specification's explicit disclosures of fugitive free depositing being prior to the heat treatment which forms the porous network.

New claims 32 & 41 are directed to a newly claimed issue of employing a target which is "a molybdenum disk surrounded by a **solidified ceramic** material and **directing an electron beam** in alternating fashion at the molybdenum disk and **solidified ceramic** material" (emphasis added). Again, no support was cited by applicants, and the closest support found by the examiner is figure 1, [0010], [0018] & [0023], however exemplary target structure provided in this figure & descriptive paragraphs thereof is not consistent with the new claim language. Specifically, the structure at which the disclosed electron beam is directed at is a solid Mo disk that is surrounded by "particulate 7YSZ", or in the generic description "particulate ceramic", and it is only **after** use as a target, that the surrounding ceramic is described as "solidified", hence the original specification explicitly **does not employ** a solidified ceramic material as claimed, therefore these claims as written include **New Matter**.

New claims 34 & 43, appear to be a composite of previously examined claim 11 & original product claim 20, where the basis of the value "at least 90 %" has been defined as "of a mass of deposited said fugitive material" (emphasis added). Again, applicants have not provided the basis of their support or any explanation of from where the support is derived. The examiner notes disclosure of the claimed pore size found in both paragraphs [0024 & 25], where the latter paragraph also disclosed "While 100% evacuation of fugitive material from the co-evaporated combination of the fugitive material and the matrix TBC is preferred, it is sufficient that at least 90% of the fugitive material is liberated and removed from the TBC", which provides support for combining the pore size & the residual percentage of fugitive material, but does not provide support for the calculation of the basis of that percentage being "of a mass". Hence, one must look to preceding disclosures to determine if there is any clear & necessary disclosure applicable to this percentage value. Unfortunately, several different ways of describing percentages were found, which were not consistent with each other. Also in [0025], there is disclosed "...to result, post liberation, in the removal of no more than 70% by weight of the matrix TBC" (weight is related to but not the same as mass). In paragraph [0024] was found the disclosure "the total reduction in mass of the matrix TBC **per unit volume** was shown to range from 5% to 40%" (emphasis added), where it is noted that the percentages are with respect to volume, although the sentence generically relates to value to mass, but they are not measured in "mass". A further relevant percentage value can be found in paragraph [0022], which discloses "remove... to produce a pore structure having a 27% volume fraction as compared to pure 7YSZ", where it is clear that the percentage value is based on volume measurements. From these disclosures, it can be determined that two different types of percentage measurements were made, those based on weight & those based on volume, but in neither case were these measurements directly related to the fugitive material, whose residual percentage after heating is being claimed, hence the examiner cannot say from reading the specification, what the basis for the 90% necessarily is, and the examiner found no

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basis for claiming that the 90% was necessarily be derived from "mass", thus these claims also appear to encompass **New Matter**.

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims **35-38** are rejected under 35 U.S.C. **102(b)** as being anticipated by **Strangman** (5,624,721).

Claims **35-38 & 42-43** are rejected under 35 U.S.C. **103(a)** as being unpatentable over **Strangman** (721).

New independent claim 35 requires co-deposition of evaporated TBC & fugitive materials, where the deposition rates of these materials are altered at different levels of the deposit, and that during the heating step at least a portion of any fugitive material that is in a level will be liberated therefrom. Note that this does not necessitate positive deposition of fugitive material in all levels, especially since read in light of applicants' specification, such as in [0023] or [0021], co-deposition via evaporation appears to include alternating deposition materials with & without the fugitive material, or various options for continuous gradation. The teachings Strangman (721) are consistent with the alternating option, in that after they are EB-PVD deposition of initial (first portion) zirconia layers (ref #26; col. 3, line 55-col. 4, line 3); and they then deposit a second portion (ref #28; col. 4, lines 4-41) of multiple layers, which includes a metallic vapor, such as tungsten or molybdenum, evaporated simultaneously with the zirconia vapor (TBC matrix); followed by an outer portion (ref #28; col. 4, lines 42-56), which is made by sputtering noble metal concurrently with deposition of the zirconia, with no mention of W or Mo also being evaporated at this time for the outer portion, although the interaction of the noble metal as being attracted to W or Mo to form in intermetallic, which results in coated pores when the W or Mo oxidizes, is discussed. Note the outer portion coating procedure may be interpreted to mean it was without concurrent deposition of fugitive material (W or Mo), with the noble metal being attracted to the fugitive material deposited in the preceding sub layer(s), thus reading on altering the deposition rates, such that no fugitive material is deposited in the first portion & the outer portion, with the subsequent heat treatment causing removal of fugitive material from the second portion & through the outer portion, especially at the interfacing of deposits. Alternately, one *might* interpret the explicit mention of the noble metal being attracted to the W or Mo to form intermetallics as *implying* concurrent deposition of W or Mo with the zirconia (but the language certainty does not necessitate this), where it is noted that addition of a third component, the noble metal, to the deposition mixture would inherently cause some alteration in rates of

deposit, as well as concentration or distribution of deposited mixtures, thus *could* also be considered to read on the claim language.

Note that while Strangman's procedure (the most reasonable interpretation) is consistent with options for outer coating without fugitive material as taught in the body of applicants' original disclosure, it is not consistent with applicants' newly claimed, unsupported limitation of depositing TBC coating material on the already formed porous layer, although since the discussion of the outer portion is after the discussion of the growth of the stabilized porosity due to post-treatment heating, one could similarly misinterpret (as new claims 26-34 & 44 might be said to misinterpret applicants' original specification) Strangman (721)'s specification to say that the deposition is after the porosity formation due to heating, but the context of the outer portion coating appears to indicate the noble metal atoms are present when the tungsten or molybdenum atoms have not yet oxidized, thus enabling the noble metal to coat the pores when they are formed.

It is further noted that Strangman (721) discuss that the typical pore sizes created in their stabilized porosity section will have diameters of about 5.0-500.0 nm, thus encompassing claimed diameters as recited in new claim 43.

As previously discussed, Strangman (721) teach deposition of TBC layers, including yttria stabilize zirconia, on superalloy turbine engine vanes or blades, where a series of EP-PVD deposits are sequentially made, such that the initial deposition is an unstable porous TBC layer (no fugitive material & expected to densified on sintering), then the TBC porous layer is deposited with tungsten or molybdenum, where the source for EB evaporation may be a powder mixture of W or Mo powder with the TBC material, or W or Mo wire may be added to the stabilized circuit via evaporation source. EP-PVD processes at 950-1100°C are taught to effect stabilization of the porosity as deposited, such that the thermal conductivity of the ceramic player is reduced in comparison with densified sintered materials. Alternately, it is also taught to grow and stabilize the porosity via an oxidizing post coating heat

treatment, where the W or Mo components are removed by oxidation to gaseous oxides, whose difficulty in defusing out during the sintering process prevents densification, thus growing & stabilizing the porosity. The surface of the stabilize that TBC layer has its pores coated with noble metals, which effectively decreases the porosity at the surface, such that there can be said that the overall structure of the TBC coating has varied porosity, hence a gradient. In Strangman, particularly see the abstract; figure; col. 3, line 35-col. 4, line 56.

While specific temperatures for post-treatment heat treatment alternative are not discussed, the deposition temperatures for as deposited stabilized porous material would have been expected to provide one of ordinary skill in the art with a starting point for routine experimentation, to determine optimum temperatures required to effect analogous results in a post-treatment of a complete thickness of a deposit, rather than occurring as depositing, plus note Strangman also mentions growing, as opposed to merely stabilizing the porosity in the post-treatment, for which temperatures expected to grow, i.e. increase, the porosity, when optimized would have been expected to be inclusive of higher claimed temperature ranges.

While the percentage of fugitive material liberated, or the porosity percentage value, or the like are not provided, it would have been obvious to one of ordinary skill in the art to employ the teachings of Strangman to optimize the porosity in order to optimize production of the low thermal conductivity consistent with the teachings, which would have been expected to effect values as claimed, especially considering the remaining uncertainty of their meaning as discussed above & the lack of significant different processing steps.

It is further noted that as applicants' specification & deposition procedures covered by the scope of the claims suggest or imply possible options of continuous grading of fugitive material, that with respect to such options, the teachings of Strangman (721) neither explicitly include nor exclude gradation on a continuous basis of the amount of metal vapors, such as tungsten or molybdenum, that may be introduced to form porosity during heat treatment, but as they teach that the second portion has greater

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porosity than the first portion, and teach criteria for limiting the amount of the small concentration of these metallic vapors, such that isolated submicron particles of the metals will be formed on or in the zirconia layers & there will not be so much added so that extensive channel formation interconnecting pores will form, with further consideration of above discussed teachings concerning the outer portion, it would've been obvious to an ordinary skill in the art to use concentrations ranging from those that will initiate the particulate formation up to those just short of creating the undesired channel structures, where Strangman's taught multilayered structure would suggest to one of ordinary skill in the art some continuous gradation between initial first portions & final outer portions, which lack the W or Mo additives as the taught separate means of introducing the fugitive metallic vapor may be separately controllable & explicit discussion of multilayers suggests that all layers within designated portions need not be identical.

7. Claims **39-41** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Strangman (721)** as applied to claims 35-38 & 42-43 above, and further in view of **Movchan et al.** (EP 1327698 A).

While Strangman (721) discusses various options (col. 4, lines 4-16) For supplying both the TBC ceramic (zirconia) & the fugitive material (W or Mo), including both separate or combined deposition sources, mentioning tungsten or molybdenum may be added as either powder or wire to the stabilized zirconia source, they do not specifically mention use of ingots or a target with uniform distribution or use of a molybdenum disk surrounded by ceramic (solidified as unsupported or particulate as supported by applicants' original specification), however any of these options would be consistent with the general disclosure, noting that addition of a fugitive material wire to a zirconia evaporation source, would have been suggestive to one of ordinary skill in the art of inserting the wire up through a powder source, as it would be difficult to add a wire to a solid source. It would've been obvious to one of ordinary skill in the art given the teachings of Strangman (721) of the various options capable of introducing the 2 materials simultaneously, either together or separately, to use any conventional source configurations known for

introduction of multiple material simultaneously during EB-PVD evaporation techniques, where the process of Movchan et al., as previously discussed (and repeated below), provides teachings of such other alternatives as claimed, employed for analogous deposition processes for analogous purposes, providing additional expectation & motivation for the expected effectiveness of these alternative source configurations as claimed.

As previously discussed, Movchan et al. teach EB-PVD of thermal barrier coatings (TBC) material using ingots of either mixed material or separate ingots of several percent yttria in yttrium stabilize zirconia, and of graphite as a carbon source, to deposit a mix to layer containing carbon, which is then thermally treated, such as by centering (950°C or 900-1200°C, i.e. 1768°F or 1678-2118°F), so as to remove the carbon, i.e. fugitive material, and thus maintain or increase the porosity of the initially deposited EB-PVD layer. Note that the sintering process by definition is not a process that melts, hence would not have melted the substrate. Mentioned substrates include superalloy gas turbine components. Exemplary experimental data discusses initial depositions having open porosity of 32 volume % as compared to 12% for conventionally deposited 7% YSZ, after which heating was performed & resulting densities measured (% porosity not given). See the abstract, [0019], [0021-25] & [0028-29].

While particular volume percentage porosity after heating is not given, it is taught that the porosity may be increased by the heating process, hence it would have been obvious to one of ordinary skill in the art to employ the taught process to produce such taught increases in porosity, which would have been expected to include volume percentage values for porosity greater than 32 volume %, thus one of ordinary skill in the art would expect such porosity values to include possible meanings of claim 14.

Movchan et al. discusses chemical mechanisms by which the carbon is removed by post-treatment heating processes, but does not mention a value percentage (basis unspecified) of carbon removed or remaining, however it is apparent from the overall discussion that the majority of the carbon would have been expected to be removed as gaseous products, thus would have been obvious for one of

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ordinary skill in the art to heat sufficiently to remove on the order of 90 % of the carbon as claimed, especially considering the carbon *per se* is not a desired structural component, but intended to be removed, especially for the taught increase in porosity, and it would have been further obvious to one of ordinary skill in the art to optimize this removal & the taught increase in porosity via optimization of the heating technique to optimize the taught porosity increase, for which one would have expected to produce with larger concentrations of carbon material as per discussion in [0029]. Also given the lack of significant differentiation in process steps, results would have been expected to be inherently the same.

While Movchan et al. do not discuss a target with homogeneous mixture of carbon & TBC material, they do discuss that just ingot containing both materials to be deposited may be employed ([0022]), hence it would've been obvious to one of ordinary skill in the art when employing a single target to use a homogeneous mixture of material, otherwise when electron beam evaporation at a localized site on the ingot (= target) cannot occurs, nonuniform evaporation of material would occur resulting in highly nonuniform compositional deposits, which could create defects in the product, such as overly large voids, which when treated to remove the carbon could create discontinuities in the barrier layer.

8. Claims 26-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Strangman** (721), in view of **Movchan et al.** (EP 1327698 A), as applied to claims 35-38 & 42-43 above, and further Allen et al. (2002/0172837 A1), noting that Movchan et al. is relevant to new claims 30-32 for reasons as discussed above.

As noted above applicants' unsupported subsequent TBC layer deposition on to the porous TBC structure does not appear to be read on by Strangman (721), although they do disclose a teaching which appears to be consistent with depositing the outer layer lacking in fugitive material as deposited, thus suggesting to one of ordinary skill in the art that higher density for the outer layer is desirable. Allen et al. (figure 5; [0052] & [0055-56]), who also provides teachings concerning TBC layers having pores formed via use a fugitive material, additionally teaches the desirability as illustrated in figure 5 of the

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surface layer being dense & compact, so as to form a protective layer for the underlying TBC, hence it would've been obvious to one of ordinary skill in the art to employ known means of depositing or forming an outer layer sufficiently dense to be a protective layer as suggested, which would have reasonably suggested to one of ordinary skill in the art the desirability of subsequent EB-PVD deposition after formation of the porous layer of an additional TBC surface coating, like that deposited before the heating without the fugitive material, which would not have been expected to form porous structures in the surface, hence produce a denser layer than would be produced if vapor deposited before the heat treatment producing the porosity where the occluded gases would need to pass through the outer deposit, especially if the final deposit was provided with a further heat treatment to fuse as suggested by Allen et al. & would be a consistent alternative to the outer layer of Strangman (721).

9. Applicant's arguments filed 1/11/2008 & discussed above have been fully considered but they are not persuasive.

10. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

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11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Marianne L. Padgett whose telephone number is (571) 272-1425. The examiner can normally be reached on M-F from about 8:30 a.m. to 4:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks, can be reached at (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Marianne L. Padgett/
Primary Examiner, Art Unit 1792

MLP/dictation software

4/27-28/2008